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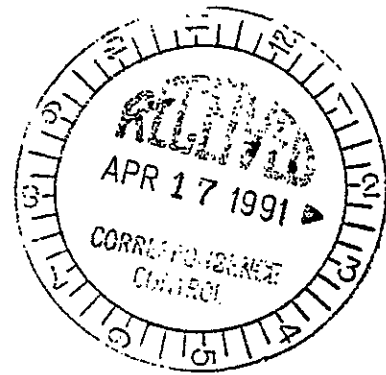
Department of Energy

Richland Operations Office

P.O. Box 550

Richland, Washington 99352

APR 0 8 1991



91-WOB-118

Mr. Timothy L. Nord
Hanford Project Manager
State of Washington
Department of Ecology
Mail Stop PV-11
Olympia, WA 98504-8711

Dear Mr. Nord:

LIQUID EFFLUENT RETENTION FACILITY CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN

At the meeting between Washington Department of Ecology (Ecology), Kaiser Engineers Hanford (KEH) Company, and Westinghouse Hanford Company (Westinghouse) held on April 5, 1991 in Richland, WA, the CQA Plan was presented to Mr. Gary Anderson of Ecology. This Revision 4 incorporates the lessons learned from the Test Fill Pads constructed during December 1990 and utilized to accumulate data on the permeability of the soil/bentonite mixture. The document provides for construction of the Liquid Effluent Retention Facility (LERF) basins to follow the same methods as used in the Test Fill Pads.

As identified in the April 5, 1991 letter to yourself from me, entitled, "Transmittal of Soil/Bentonite Permeability Testing Final Report and Additional Information Requested" it is our intention to initiate construction activities of LERF by April 15, 1991. If you have any objections please indicate so by April 10, 1991. You may contact Mr. Cliff Clark of this office on 376-9333 if you have any questions.

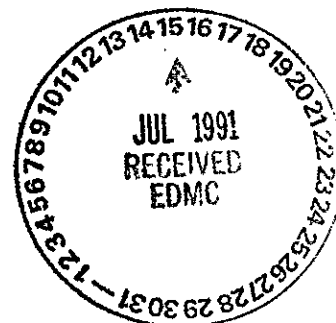
Sincerely,

Steven H. Wisness
Hanford Project Manager
Tri-Party Agreement

WMD:RJN

Attachment

cc w/att:
P. Stasch, WDOE
T. Michelena, WDOE
G. Anderson, WDOE
P. Day, EPA



242-A EVAPORATOR INTERIM RETENTION BASIN
CONSTRUCTION QUALITY ASSURANCE PLAN

Prepared for
WESTINGHOUSE HANFORD COMPANY

April 1991

For the U.S. Department of Energy
Contract DE-AC06-87RL10900

Prepared by
KAISER ENGINEERS HANFORD COMPANY
Richland, Washington

Hanford Project Office

APR 15 1991

Environmental
Protection Agency

404 3-15-91
242-A EVAPORATOR AND PUREX INTERIM RETENTION BASIN
CONSTRUCTION QUALITY ASSURANCE PLAN

Prepared by
KAISER ENGINEERS HANFORD COMPANY
Richland, Washington
for
WESTINGHOUSE HANFORD COMPANY

<u>RT Hallum</u> Principal Lead Engineer	<u>5-1-90</u> Date	<u>J. Orndorff</u> Safety	<u>5-1-90</u> Date
<u>Laura A. Galli</u> CQA Officer	<u>4-30-90</u> Date	<u>R. H. Hallenbeck</u> Environmental	<u>5-2-90</u> Date
<u>MA Long</u> Quality Service Manager	<u>5-2-90</u> Date	<u>John W. V. S.</u> Project Manager	<u>5-2-90</u> Date

Westinghouse Hanford Company

LH
5-2-90
Gary R. Porter
Projects Department

5/2/90
Date

DOES NOT CONTAIN CLASSIFIED OR
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION

E. W. C. R.
Reviewing Official/ADC
Kaiser Engineers Hanford Company

5/3/90
Date

CQAPLN2.QS.1149

Rev 3-13-91

242-A EVAPORATOR AND PUREX INTERIM RETENTION BASIN
CONSTRUCTION QUALITY ASSURANCE PLAN
CHANGE CONTROL RECORD

REVISION	DESCRIPTION OF CHANGE - REPLACE, ADD, AND DELETE PAGES	AUTHORIZED FOR RELEASE (Initial And Date)						
		PLE	CQA	QS MGR	SFTY	ENV	PM	WHC
1	Add Section 2.3.3 Low-Permeability Soil Liner, Pages 17 through 25, to CQA Plan	DKD for RTH 7-20-90	SKH 7-20-90	MAJ 7-20-90	DKL 7-20-90	RKH 7/20/90	SKP 7-20-90	SKP 7-20-90
2	Add sections listed below, Pages 26 through 46, and 52 through 65 to CQA Plan Add Section 2.3.4 Flexible Membrane Liners Add Section 2.3.5 Bentonite Carpet Liner Add Section 2.3.6 LDCRS Add Section 2.3.8 Covers Add Section 2.3.9 Miscellaneous	DKD 10/22/90	SKH 10/17/90	MAJ 10-24-90	DKL 10-23-90	RKH 10/22/90	SKP 10/24/90	SKP 10/24/90
3	Add Section 2.3.7 Mechanical and Electrical Systems, Pages 47 through 51	DKD 11/14/91	SKH 1-18-91	MAJ 1-18-91	DKL 1-21-91	RKH 1-21-91	SKP 1/21/91	SKP 1/30/91
4	General revision to update Table of Contents, Acronyms and Reference Lists, delete PUREX, modify Section 2.3.3 based on information from test fill, add field calibration of nuclear gage for S/B liner and miscellaneous editorial changes	DKD 3/13/91 4/4/91	SKH 3-13-91 4-3-91	MAJ 3-13-91 4-3-91	DKL 3-13-91 4-4-91	RKH 3-13-91 4-4-91	SKP 3/13/91 4/4/91	SKP 4/4/91

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APPENDICES

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ACRONYMS

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BCL	Bentonite Carpet Liner
CFR	Code of Federal Regulations
CQA	Construction Quality Assurance
DOE	Department of Energy
DOE-RL	Department of Energy-Richland Operations
EPA	Environmental Protection Agency
FML	Flexible Membrane Liner
HDPE	high-density polyethylene
KEH	Kaiser Engineers Hanford Company
LDCRS	Leachate Detection, Collection, and Removal System
NCR	nonconformance report
NDE	nondestructive examination
QA	Quality Assurance
S/B	soil bentonite
UV	ultraviolet
VLDPE	very-low-density polyethylene
WAC	Washington Administration Code
WHC	Westinghouse Hanford Company
WSDOE	Washington State Department of Ecology
WSDOT	Washington State Department of Transportation

REFERENCES

- ANSI B31.3 - Chemical Plant and Petroleum Refinery Piping
- ASTM C 136 - Method for Sieve Analysis of Fine and Coarse Aggregates
- ASTM D 413 - Test Methods for Rubber Property - Adhesion to Flexible Substrate
- ASTM D 422 - Method for Particle - Size Analysis of Soils
- ASTM D 638 - Test Method for Tensile Properties of Plastics
- ASTM D 698 - Test Method for Moisture - Density Relations of Soils and Soil Aggregate
- ASTM D 774 - Test Method for Bursting Strength of Paper
- ASTM D 792 - Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement
- ASTM D 1004 - Test Method for Initial Tear Resistance of Plastic Film and Sheeting
- ASTM D 1238 - Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
- ASTM D 1593 - Specification for Nonrigid Vinyl Chloride Plastic Sheeting
- ASTM D 1603 - Test Method for Carbon Black in Olefin Plastics
- ASTM D 1682 - Test Methods for Breaking Load and Elongation of Textile Fabrics
- ASTM D 1777 - Method for Measuring Thickness of Textile Materials
- ASTM D 2434 - Test Method for Permeability of Granular Soils (Constant Head)
- ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3083 - Specification for Flexible Poly(Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining
- ASTM D 3776 - Standard Test Methods for Mass for Unit Area (Weight) of Woven Fabric
- ASTM D 3787 - Test Method for Bursting Strength of Knitted Goods: Constant-Rate-of-Traverse (CRT), Ball Burst Test
- ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D 4533 - Standard Method for Trapezoid Tearing Strength of Geotextile
- ASTM D 4632 - Test Method for Breaking Load and Elongation of Geotextile (Grab Method)

REFERENCES (Continued)

- ASTM D 4716 - Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products
- ASTM D 4751 - Test Method for Determining the Apparent Opening Size of a Geotextile
- ASTM D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- EPA-560-SW-86-031 - Construction Quality Assurance for Hazardous Waste Land Disposal Facilities
- WAC-173-303 - Dangerous Waste Regulations
- WSDOT M41-01 - Washington State Department of Transportation Construction Manual
- WSDOT M41-10 - Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction
- 40 CFR-260-270 - Code of Federal Regulations, Protection of Environment

242-A EVAPORATOR INTERIM RETENTION BASIN
CONSTRUCTION QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

1.1 Purpose of Construction Quality Assurance Plan

This Construction Quality Assurance (CQA) Plan describes the methods utilized to ensure that the construction of the 242-A Evaporator Interim Retention Basin is performed in accordance with approved procedures, and the established acceptance criteria of the design specifications and drawings. The CQA Plan also describes the responsibilities and authority of personnel, personnel qualifications, inspection activities, sampling, and how the records that document these processes are controlled and maintained.

1.2 Applicable Guidance Documents

- . Environmental Protection Agency (EPA)/530-SW-86-031 - Technical Guidance Document, Construction Quality Assurance for Hazardous Waste Land Disposal Facilities.
- . 40 Code of Federal Regulations (CFR) Part 260 - 270.
- . Washington Administrative Code (WAC) 173-303.

1.3 Document Users and Authority

This document will be used and implemented by the CQA Officer for future 242-A Evaporator Interim Retention Basin Construction projects.

1.4 Management of Quality Services

The construction quality of the project will be assured by quality service organizations for the owner/operator, Department of Energy Richland Operations (DOE-RL); the co-operator, Westinghouse Hanford Company (WHC); and the engineering/construction contractor, Kaiser Engineers Hanford (KEH). First line quality assurance (QA) shall be the responsibility of the project construction contractor, the KEH Quality Services organization, and the CQA Officer.

Personnel performing QA activities (i.e., inspection, overview, and surveillance), or any other phase of project QA under the guidance of the CQA Officer will, herein, be referred to as CQA personnel.

The project specific Quality organization chart is illustrated in appendix A.

1.5 Document Scope

This document was prepared by using the documents listed in Section 1.2. It will be used in conjunction with the drawings, specifications, and other contract documents to assure the 242-A Evaporator Interim Retention Basins are constructed as designed. The CQA Plan does not replace those documents, nor does it add to or relieve the contractor of any of his contractual obligations.

2.0 COA PLAN ELEMENTS

2.1 Responsibilities, Authority, and Control

2.1.1 Organizations Involved In COA

2.1.1.1 Facility Owner/Operator

WHC, as the facility co-operator, under contract with the owner, DOE-RL, is responsible for operation of the 242-A Evaporator Interim Retention Basins. This responsibility includes complying with requirements of the permitting agency in order to obtain a permit and, by submission of CQA documentation and reports, ensuring that the facility was constructed as specified in the design. WHC relies on the design engineer, the CQA personnel and the CQA Officer to provide QA for the basin construction project.

2.1.1.2 Engineer Services

The 242-A Evaporator Interim Retention Basin is designed by KEH based on the design criteria received from WHC.

KEH, the design engineer is responsible for the review and acceptance of specified contractor submittals to ensure materials, procedures, and fabrication and installation drawings, for the proposed construction, comply with contract documents. The engineer is also responsible for resolving construction deficiencies (nonconformance reports [NCRs]).

2.1.1.3 Contracts Administration/Manager

The formal interface between the construction contractor and the owner/operator will be provided by KEH Construction Management. The Contract Administrator assembles bid documents, advertises for bids, evaluates bids, and awards the contract. Correspondence processed by the Contract Administrator to/from the Contractor include, but are not limited to, submittals, contract changes, construction definition, NCRs, meeting minutes, and process claims, as required.

2.1.1.4 Quality Services

KEH is authorized to perform construction acceptance for the owner, DOE-RL. The KEH Quality Services organization will implement the requirements of this CQA Plan. This group will perform the required inspection and review and approve the construction contractor's work.

2.1.1.5 Construction Contractors

Construction of the 242-A Evaporator Interim Retention Basin Facilities will be performed by KEH Construction Forces and Fixed-Price Contractors. KEH will perform work inside and outside the 200-East Area perimeter fence and will include the pipeline installation and connection to existing facilities. KEH will also purchase long lead time item to aid in expediting the project.

Fixed-Price Contractors will perform the work at the Basin Facility, outside the 200-East fence. This work will be broken into six phases or contracts. Phase I

will include basic site work including clearing and grubbing basin excavation and berm construction. Phase II will include the low-permeability soil liner system. Phase III will be the Basin Liner System and Leachate Collection System. Phase IIIa will be the Basin Cover System. Phase IV will be the Mechanical/Electrical/Instrumentation System. Phase V will include miscellaneous site support facilities (i.e., cleanup and fencing.) The Fixed-Price Contractors will be qualified and selected through a competitive bidding process.

The construction contractors are responsible for following the requirements of the contract documents, and the contractors QA plan. Various methods are used to ensure contractor compliance, such as surveillances, inspections, and resultant documentation written by the KEH Quality Services organization and monitored by the CQA Officer. If contract deficiencies or noncompliances are discovered, nonconformance tags will be used to identify or stop the work until such time as a satisfactory resolution is obtained. The CQA Officer will track any such noncompliances and ensure that deficiencies are corrected.

2.1.2 Meetings

2.1.2.1 Preconstruction Meeting

A meeting will be scheduled by KEH before the start of each work phase. Authorized representatives from the construction contractor and major subcontractors shall attend. KEH will advise others with interest in the project. The meeting will be chaired by KEH.

The following items, as a minimum, will be incorporated into the meeting agenda:

- . Point of contact, key personnel (Operating Contractor, Safety, CQA personnel, etc.) and contracts personnel.
- . Schedule requirements and restraints, submittals and work limitations.
- . Safety, construction progress meetings and frequency, and certified payrolls.
- . Report requirements and frequency.
- . Quality requirements.
- . Major material and equipment lists.
- . Basin liner and cover preinstallation meeting.
- . Other pertinent items.

2.1.2.2 Construction Progress

Weekly construction progress meetings will be held at the project site and will be attended by key personnel from Contract Administration, construction contractor, and Quality Services.

The purpose of the meetings is to monitor status and provide a forum for exchange of pertinent project information. Major topics will include, but not be limited to, the following:

- . Schedule, cost, and construction status.
- . Design and scope changes.
- . Submittal status, key material, and equipment delivery status.
- . Potential problem or work deficiency areas.
- . Inspection and testing status.
- . Action item status, goals for next meeting.
- . Other appropriate items.

Minutes will be issued by KEH promptly following each meeting. Action items will be identified with assigned followup. Resolved issues will be reported in the minutes, as well as closed action items.

2.1.2.3 Daily Status Meetings

In addition to the above, the CQA Officer, or his designee, will conduct an informal daily progress meeting just prior to commencement or following completion of work. This meeting will be attended by the CQA personnel and the construction contractor to:

- . Review the previous day's activities and accomplishments.
- . Review the work location and activities for the day.
- . Discuss any potential construction problems.

Information from these meetings will be recorded on the
Inspector's Daily Record.

2.2 CQA Personnel Qualifications

2.2.1 CQA Officer

The CQA Officer is assigned responsibility for all aspects of this CQA Plan and its implementation. He/she will have the technical education, training, and experience in engineering and QA activities to oversee the CQA plan. The CQA Officer, as a minimum, will have the following responsibilities.

- . Review drawings and specifications for clarity and completeness so that the CQA plan can be implemented.
- . Define QA requirements compatible with the project objectives.
- . Provide orientation to CQA inspection personnel on CQA requirements and procedures.
- . Schedule and coordinate inspection and surveillance activities. Including assuring that the contractor is in compliance with drawings, specification, codes, and contractor procedure.
- . Direct and support the inspection personnel in performing observations and tests by:
 - Submitting samples (knowns, duplicates, and blanks) for analysis by the inspection personnel and one or more independent laboratories.
 - Confirming that regular calibration and certification of testing equipment is properly conducted and recorded.

- Confirming that the testing equipment, personnel, and procedures do not change over time or making sure that any changes do not adversely impact the inspection process.
- Confirming that the test data are accurately recorded, adequately cross-referenced, and retrievable (this may involve selecting reported results and backtracking them to the original observation and test data sheets).
- Verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted.
- . Verify that basic data are reasonable and complete.
- . Monitor the QA activities of the testing laboratories, assuring conformance with authorized policies, procedures, and sound practices, and recommend improvements as necessary.
- . Verify that the contractor's construction quality control plan is in accordance with the requirements of the contract specification.
- . Report to the contractor results of all observations and tests as the work progresses and interact with the contractor to provide assistance so that materials comply with the specified design.

The specific qualifications for the CQA Officer are contained in Appendix B.

2.2.2 CQA Inspection Personnel Responsibilities

The CQA Officer shall be aided by qualified inspection personnel whose responsibilities, as a minimum, will include:

- . Performing independent offsite and onsite inspection or surveillance of the work in progress to assess compliance with the facility contract documents.
- . Verify that the equipment used in testing meets the test requirements and that the tests are conducted according to the standardized procedures defined by the CQA plan.
- . Reporting to the CQA Officer results of all inspections, including work that is not of acceptable quality or that fails to meet the specified design.
- . Logging in samples, assuring that sampling is conducted in a manner consistent with approved guidelines, and reviewing all field laboratory data before the data are reported or entered into the database for analysis. Also responsible for assuring that sample handling procedures are in accordance with the appropriate guidelines for the testing to be conducted.

The specific qualifications for inspection personnel are contained in appendix B.

2.2.3 Construction Contractor Inspection

It is the responsibility of the construction contractor to construct the 242-A Evaporator Interim Retention Basin in strict accordance with contract documents while using the appropriate construction procedures and techniques.

Specific hold points are identified in the contract documents to ensure that construction does not continue until the required inspection points have been completed by CQA personnel.

2.3 Inspection and Verification Activities

2.3.1 General Activities

2.3.1.1 Quality Construction Program

Contractor quality will be controlled through Contract Document, i.e., procedures drawings, submittals and specifications requirement. Additionally the liner manufacturer will be required to have a quality program.

2.3.1.2 Test and Examinations

Tests and examinations shall be performed in accordance with the CQA Plan. Testing shall be performed by personnel qualified and certified to perform the test. If testing is performed by an offsite laboratory, the laboratory shall be certified to perform the testing and will have a quality program to assure accuracy of the testing. Satisfactory completion and correctness of all items shall be verified by the CQA Officer's signature on the CQA Plan documents.

2.3.1.3 Material Verifications

CQA personnel verify that construction materials conform with contract specifications and approved contractor material submittals.

2.3.1.4 Nondestructive Examination/Destructive Test

Nondestructive and destructive tests will be performed. Results of these tests will be documented and verified by the CQA personnel.

2.3.1.5 Surveillances

Surveillances of the manufacturers' program and facilities will be performed by CQA personnel.

2.3.1.6 Equipment Calibration

Major testing equipment used by CQA personnel include:

- . Field density meters
- . Pressure gauges

This section describes the calibration of this equipment.

Other testing equipment, as required, will be calibrated in accordance with manufacturers recommendations.

2.3.1.6.1 Field Density Test Equipment

Field density tests will be conducted using a nuclear density gauge and American Society for Testing and Materials (ASTM) D 2922. All density test equipment used at the jobsite will be inspected to ensure that it is in proper working order and meets the appropriate ASTM or manufacturers' specifications. The equipment identification numbers will be recorded in the inspectors daily report and on the soil test data sheet. These identification numbers will be used in the documentation of the equipment calibration.

Nuclear density gauges shall be recalibrated on a 12-month frequency in accordance with ASTM D 2922 and the manufacturer's recommendations.

Moisture and density standard counts will be taken at the beginning of each day's use in accordance with manufacturers' recommendations and recorded on a gauge log. The CQA Officer will review this log to detect changes that may indicate a defective gauge.

Defective gauges will be marked "out-of-service" and removed from the jobsite. The gauge will not be used again until repaired in accordance with manufacturers' recommendations and checked to verify stability.

Soil-Bentonite (S/B) Liners: When the nuclear density gauge is used to determine density of S/B liners, the calibrations of the gauge shall be verified using the field calibration methods of ASTM D 2922. The S/B test fills may be used to perform the field verification. Checking and adjusting the calibration will be made in accordance with Section 4.2 of ASTM D 2922.

2.3.1.6.2 Pressure Gauge

All pressure gauges used at the jobsite will be inspected to ensure that they are in proper working order and meet the appropriate American National Standards Institute (ANSI) or manufacturers' specifications. The equipment identification numbers will be recorded in the inspectors daily report. These identification numbers will be used in the documentation of the equipment calibration.

Pressure gauges will be recalibrated on a 6 month frequency. Gauges that have been dropped, damaged, or appear to be giving invalid readings will be tagged, removed from service and recalibrated.

Manufacturers' recommendations are followed when recalibrating the gauges.

2.3.2 Foundation and Berm Construction

Foundation and berm construction will happen concurrently through a excavation and fill process. Approximately 300,000 yd³ of soil will be excavated and 200,000 yd³ of structural backfill will be placed to form the basin berms, piping berms, access roadways, and site leveling.

Initially the site will be leveled to approximate elevation of 593.0. The top 1 to 2 ft of silty sand will be removed and placed outside berm locations. The remainder of the material, a well graded gravel, with sand, silt and cobbles up to 6 in., will be used for the site leveling and berm construction. The material excavated from the retention basin will also be used for berm construction.

The bottom elevation of the three retention basins will slope from 572.0 in the northwest corner to 576.0 in the southeast corner. The top of basin berm elevation will be 603.0 with the surrounding elevation of 593.0.

2.3.2.1 Line and Grade

The site leveling excavation and berm lines and grades shall be established by the general contractor using control points identified in the contract documents.

The contractor shall employ a registered professional land surveyor to stake construction dimensions in the field. Field notes and calculations will be routinely furnished to the CQA Officer for review. The general contractor shall give the CQA Officer sufficient notice to observe the location activities.

The CQA personnel will perform spot checks of the grading operations and berm construction and use independent surveys to verify final grade evaluation.

2.3.2.2 Clearing and Grubbing

CQA personnel will observe clearing and grubbing activities to ensure that debris and organic materials unsuitable for backfill activities are removed, stockpiled and are not used for any structural backfill or berm construction.

2.3.2.3 Structural Backfill Material Placement

CQA personnel will observe structural backfill and berm construction activities to ensure:

- . Backfill materials are free of frozen particles, lumps, cobbles greater than 6 in., organic matter and trash.
- . The material is placed in lifts that will allow attainment of the specified degree of compaction.

Backfill material not meeting specifications will be removed.

2.3.2.4 Compaction

The Contractor will be required to perform a backfill placement demonstration to demonstrate the proposed method of placement and compaction of the material.

CQA personnel will observe the compaction activities and perform spot compaction testing where material allows to ensure they are conducted in accordance with the

construction drawings and specifications. Items to be observed or measured include lift thickness, size and type of compaction equipment, the number of passes by the equipment, moisture content, and compaction.

Field density and moisture tests will be conducted using a nuclear density gauge and ASTM D 2922 and ASTM D 3017. If material allows, at least one field-density test for each 500 yd³ or for each lift of compacted fill will be conducted by inspection personnel at random locations. If field density testing is not feasible, then the compactive effort will be verified by inspection personnel.

All required testing will be completed and accepted before the subsequent lifts are placed.

2.3.2.5

Proof Roll

CQA personnel will observe the proof rolling (final compaction) of the subgrade. Items observed will include amount of moisture added and the number of passes with a roller.

2.3.3 Low-Permeability Soil Liner

A low-permeability soil liner - S/B - will form a part of the bottom composite liner. Approximately 42,000 yd³ (60,000 tons) of S/B mixture will be required to form the liner in the three basins.

After the basins have been excavated and the berms constructed, the entire basin will be proof-rolled, thereby providing a uniform compacted subgrade. A geotextile will be placed directly on the subgrade prior to installation of the 3 to 3.5 foot S/B liner. Until the flexible membrane liner is installed, the S/B liner will be covered with a temporary 6-mil white polyethylene sheeting to protect the soil liner and maintain the moisture content.

2.3.3.1 Geotextile

2.3.3.1.1 Delivery, Storage, and Handling

Upon delivery of the geotextile to the site, the following activities will take place:

- . The material will be verified to assure conformance to specifications and inspected for damage.
- . The storage and handling of the geotextile will be observed by CQA personnel to ensure it complies with manufacturer recommendations. The following requirements will be met:
 - Geotextile rolls will be kept in ultraviolet (UV) protective wrapping until installation. Rolls delivered to the site without UV protective wrapping will be rejected.

The material will be kept as dry and free of dirt and debris as possible.

2.3.3.1.2 Sampling and Testing

Geotextiles may be tested to ensure conformance to the specifications. If deemed necessary by the CQA Officer, two samples (from different rolls) from each lot will be sampled by CQA personnel. Samples will be full roll width and at least 5 ft long. The inner and outer wraps of the roll will be excluded from the sample.

The following laboratory tests will be performed, if required, on the samples:

- . Grab Tensile Strength, ASTM D 1682
- . Puncture Strength, ASTM D 3787
- . Apparent Opening Size, D-4751
- . Thickness, ASTM D 1777
- . Tear Strength, ASTM D 4533

Materials for which the samples did not comply with specifications will be rejected and removed from the project site.

2.3.3.1.3 Geotextile Placement

The CQA personnel will observe the placement of the geotextile to ensure it conforms to the requirements of the drawings and specifications. Each joint overlap or seam will be checked for compliance with specifications. Damaged material will be marked, removed and replaced.

2.3.3.2 Soil Bentonite

2.3.3.2.1 Soil

CQA personnel will closely monitor the soil borrow area during borrow operations. The soil will be visually examined for changes in soil characteristics and the presence of deleterious materials, such as rocks or organic materials. Random soil samples will be taken for soil particle size analysis, using ASTM D 422. Soil gradation will conform to the requirements of the specifications. Soils not meeting the requirement will be rejected and not used in the test fill or liner construction.

2.3.3.2.2 Bentonite

CQA personnel will observe the delivery, storage, and handling of the bentonite to ensure it is kept dry, covered, and not contaminated with deleterious materials. Samples will be taken at random from the raw materials and tested for compliance with specifications for:

- . Free Swell
- . Soil Particle Size, ASTM D 422

Bentonite not meeting requirements will be rejected and removed from the site.

2.3.3.2.3 Soil/Bentonite Mix

CQA personnel will observe the mixing operations to verify conformance to the approved specification, mix procedures and proper mix proportions. The mixed material will be stockpiled for a 24-hour minimum period

prior to placement. Samples will be taken at random from the mixed material and tested as follows:

- . Particle Size, ASTM D 422.
- . Liquid limit, Plastic Limit, Plasticity Index, ASTM 4318.
- . Bentonite Percentage, Methylene Blue

Mixed materials not meeting the specification - requirements may be removed at the discretion of KEH.

2.3.3.2.4 Test Fill Construction

Prior to the construction of the low-permeability soil liner, a test fill will be constructed by the contractor. This fill will demonstrate and verify proposed method of construction of the facility liner and allow for permeability testing of the S/B material.

2.3.3.2.4.1 Placement, Spreading, and Compaction Operations

CQA personnel will observe the placement, spreading and compaction activities of the test fill to ensure it is constructed in the same manner and with the same equipment and soils as proposed for the liner facility.

To further ensure valid results from the test fill demonstration, CQA personnel will verify that the fill is constructed in accordance with the Contract Specifications and the following requirements.

- . The test fill shall use the same S/B material blend, equipment, and procedures proposed for the basin facilities.
- . The test fill shall be constructed at least four times wider than the widest piece of construction equipment.
- . The test fill shall be long enough to allow construction equipment to reach normal operating speed before entering the area to be used for testing.
- . The test fill shall be constructed with at least three lifts to evaluate the methodology used to tie the lifts together.
- . The test fill is of sufficient size to facilitate infiltrometer permeability testing.
- . The test fill will be constructed so as to determine the relationship of the following to the moisture content, density, and permeability:
 - Compaction equipment type, weight, and configuration.
 - Number of passes of the compaction equipment.
 - Compaction equipment speed.
 - Lift thickness (compacted/uncompacted).

- The methods used to break down clods before compaction and the maximum allowable clod size.
- The method used to control and adjust moisture content, including equilibration time and the quantity of water to be used in any adjustment.

An in-place sealed double-ring infiltrometer permeability test will be conducted on the demonstration test fill. The field measurement of infiltration rate will be in accordance with that method developed by Stephen J. Trautwein (ASTM D 5093).

Field density and moisture content tests will be conducted using a nuclear density gauge, ASTM D 2922 and ASTM D 3017. At least one field density test for each compacted lift will be conducted by CQA personnel at random locations. The required density and moisture will be in accordance with construction specification based on WSDOT Test Method No. 609, "Method of Test for Moisture-Density Relation of Soil", similar to ASTM D 698.

All required field density and field moisture content tests will be completed before the overlying lift is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) will be completed before CQA personnel allow placement of subsequent lifts.

2.3.3.2.5 Basin Liner Construction

Following construction of the test fill and the evaluation of the documentation and soil test results, the basins low-permeability (S/B) liner will be installed.

2.3.3.2.5.1 Placement, Spreading, and Compaction Operations

CQA personnel will observe the placement, spreading and compaction activities to ensure they are conducted in accordance with the construction drawings and specifications. CQA personnel will assure that the basin liner is constructed with the same materials, equipment and compaction methods as utilized in the test fill. Items to be observed or measured include:

- . Removal of roots, rocks, rubbish, or off-spec soil from the liner material.
- . Identification of changes in soil characteristics necessitating a change in construction specifications.
- . Adequate spreading of liner material to obtain complete coverage and the specified uncompacted lift thickness.
- . Adequate clod size reduction of liner material.
- . Spreading and incorporation of soil amendments (if specified) to obtain uniform distribution of the specified amount throughout the liner material.
- . Adequate spreading and incorporation of water to obtain full penetration through clods and uniform distribution of the specified water content.

- . Procedures to be followed to adjust the soil moisture content in the event of a significant prolonged rain or drought during construction.
- . Prevention of significant water loss and desiccation cracking before and after compaction.

Field density and moisture content tests will be conducted using a nuclear density gauge, ASTM D 2922 and ASTM D 3017. At least twenty field density/moisture tests for each compacted lift will be conducted by CQA personnel at random locations. The required density and moisture will be in accordance with construction specification based on on WSDOT Test Method No. 609, "Method of Test for Moisture Density Relation of Soils" similar to ASTM D 698.

All required field density and field moisture content tests will be completed before the overlying lift is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) will be completed before CQA personnel allow placement of subsequent lifts.

Areas not conforming to specifications will be removed or recompactd.

2.3.3.3 Post Construction

Immediately before placement of any protective cover, the soil liner will be inspected for cracks, holes, defects, or any other features that may increase its field permeability. All defective areas will be removed. If the underlying foundation is defective (soft or wet), then this material also

will be removed and the resultant volume will be replaced. Excavated areas of the soil liner will be repaired by the method similar to test fill construction; inspection will ensure there is continuity between the repaired and undisturbed areas. Special attention will be paid to the final inspections of the sidewall and bottom slopes, surface smoothness, liner thickness, and the coverage and integrity of the cover placed over the liner. The completed liner will be protected from desiccation, erosion, and freezing immediately following completion of the uppermost lift.

CQA personnel shall verify by survey that thicknesses and grades are in accordance with design drawings.

Following inspection and grade verification, CQA personnel will verify the S/B liner is protected against damage until Flexible Membrane Liner (FML) is installed.

2.3.4 Flexible Membrane Liners

High-density polyethylene (HDPE) FML will form the second half of the bottom composite liner and a part of the primary composite liner. The three basins will require approximately 600,000 ft² of 60 mil HDPE for both liners.

Before the secondary FML is installed, the temporary sheeting will be removed and the S/B surface will be inspected for damage and be repaired as required. The sheeting removal will be limited to that area than can be covered with HDPE during that day's operation thereby reducing moisture loss to the S/B.

After installation of the leachate detection, collection and removal system, paragraph 2.3.6, and the bentonite carpet liner, paragraph 2.3.5, the primary FML will be installed.

Both primary and secondary FML will be anchored to a reinforced concrete curb embedded in the earth at the top of the berm. The FML will be fastened to the curb using anchor bolts and batten bars.

2.3.4.1 Preconstruction

Preconstruction activities for the FMLs will include: an evaluation of the geomembrane manufacturers' qualification and material; an evaluation of the installers qualification, drawings, and procedures; a review of delivery storage and handling methods; an overview of test seam; and jobsite material sampling.

2.3.4.1.1 Manufacturers' Qualifications and Materials

The contractor shall submit geomembrane material information obtained from the geomembrane

manufacturer for review and approval. Deviations from the construction specifications must be approved by the design engineer. The contractor will be notified of unacceptable deviations from the construction specifications. The following manufacturer information will be submitted and approved by CQA personnel prior to installation:

- . Demonstration of qualification of the geomembrane manufacturer: The manufacturer shall provide documentation of experience in manufacturing HDPE for use in hazardous waste containment applications. References of satisfactorily completed projects using HDPE geomembranes shall be included.
- . Manufacturers' Quality Control Plan: Provide details of the ingredients of the quality control plan. Particularly, document the methods used to ensure only 100% virgin materials are used. At least one sample approximately 2 ft long by full roll width, from each batch shall be obtained each day from each production line in use. The sample shall be divided; the manufacturer will test half and KEH will test the other half for:
 - Thickness, ASTM D 1593
 - Tensile Properties, ASTM D 638
 - Specific Gravity, ASTM D 792
 - Melt Flow Index, ASTM D 1238
 - Carbon Black Content, ASTM D 1603
 - Tear Resistance, ASTM D 1004

- . Certified Material Test Reports: The manufacturer shall provide certified material test reports that show the materials meet the requirements of the construction specifications.
- . Material and Resin Test Data: The manufacturer shall provide certified material test reports for the following resin test data:
 - Specific Gravity, ASTM D 792
 - Melt Flow Index, ASTM D 1238

CQA personnel will verify from the Manufacturers' Certified Material Test Report that the resin used for extrudate/fusion welding is from the same materials as the HDPE sheet resin.

CQA personnel will witness the labeling, packaging, and shipment preparation of the various pieces of geomembrane liner for specification requirement compliance.

2.3.4.1.2 Installers Qualification, Drawings, and Procedures

The contractor shall submit the following for review and approval:

- . Qualifications of the installer, including key personnel, such as the Superintendent and Foreman.
- . Installation drawings.

- . Installation instructions.
- . Care and repair recommendations.

The submittals will be reviewed for compliance with the construction drawings and specifications. Unacceptable deviations will be corrected prior to initiating geomembrane manufacturing and installation operations.

A preinstallation meeting will be held prior to installation of the geomembrane. The following parties will be in attendance:

- . The general contractor
- . The geomembrane contractor
- . The design engineer or his representative
- . The CQA Officer
- . CQA inspection personnel
- . A facility owner/operator representative

The following issues will be discussed and agreed upon by all parties:

- . Field welds and welder qualifications
- . Methods to test seams and sampling requirements
- . Characteristics of a good seam
- . Repair procedures

2.3.4.1.3 Delivery, Storage, and Handling

Delivery, storage, and handling of the HDPE materials will be observed by CQA personnel to ensure:

- . Fabricated pieces and rolls are wrapped with protective sheeting, made of the same material that is in the containers, and that they are supported to prevent damage during shipment.
- . Each roll and prefabricated piece is provided with a label traceable to the manufacturer and the manufacturers' testing results, product type, thickness, batch code, manufacture date, physical dimensions, and roll/panel number or placement number of prefabricated pieces. The labels will only be removed by CQA personnel immediately prior to installation and data being recorded on the Inspection report.
- . A Certified Material Test Report accompanies each roll or prefabricated piece.
- . The liner materials are free of punctures, tears, exposure to high temperatures, bonding of adjacent membranes, or crumpling from inadequate support.
- . The materials are stored off the ground on dunnage, in a secure area and sheltered from adverse weather.

2.3.4.1.4 Test Seams

Prior to geomembrane liner installation and seam welding, the geomembrane contractor will prepare test seams to demonstrate welders, equipment, and weld procedures under field conditions outlined in the construction specifications.

The test seams will be approximately 10-ft long and will be both destructive and nondestructive tested.

The test seams will be 100% visually inspected and a nondestructive test, either pressure or vacuum box test, will be performed. The entire seam must pass these inspections and nondestructive testing.

Destructive tests will be performed as follows:

- . The test seam, excluding 1 ft on each end, will be divided into two parts. One part will be used by the geomembrane contractor who will perform testing, and the other part will be used by CQA personnel for independent laboratory testing.
- . Seams will be tested by the geomembrane contractor for Peel Adhesion ASTM D 413. CQA personnel may observe these tests. Seam qualification will be evaluated on the basis of film-tear bond type failures.
- . Samples from the part retained by CQA personnel will be sent to the laboratory for testing. The following tests will be performed:
 - Peel Adhesion, ASTM D 413
 - Bonded Seam Strength, ASTM D 3083
- . A minimum of three samples from each part will be tested. Two of the three laboratory samples shall meet the construction specifications and the third sample shall attain 95% of the specified value.

2.3.4.1.5 Material Sampling and Testing

CQA personnel will take random samples of the geomembrane materials delivered to the project site. One sample will be taken for each 50,000 ft² of material or portion thereof. The following will apply:

- . The samples will be full roll width and at least 2 ft long.
- . The inner and outer wraps of the roll will be excluded from the sample.
- . The field thickness will be measured for each sample taken.
- . Samples will be sent to the laboratory for independent testing. The laboratory testing will include:
 - Thickness, ASTM D 1593
 - Specific Gravity, ASTM D 792
 - Melt Flow Index, ASTM D 1238
 - Carbon Black Content, ASTM D 1603
 - Tensile Properties, ASTM D 638
 - Tear Resistance, ASTM D 1004
- . Material that does not meet the specification requirements will be rejected and removed from the project site.

2.3.4.2 Construction

Following approval of all preconstruction activities, the contractor/installer will be allowed to proceed with FML installation. CQA personnel will observe installation and obtain seam test coupons.

2.3.4.2.1 Installation

CQA personnel will observe the geomembrane installation for the following items to ensure:

- . Surfaces are free of sharp objects or debris-that could puncture the geomembrane.
- . Proper climatic conditions for liner installation and seaming.
- . The geomembrane material is clean and free of moisture prior to seaming.
- . Welders' qualifications
- . Proper preparation of the seams.
- . Grinding of the seam areas is not excessive.
- . Geomembrane is not damaged during seaming.
- . Amount of material slack is sufficient to prevent trampolining. This observation will be made in the coolest part of the day.

- . Placement of material, including prefabricated pieces, is in accordance with approved installation drawings.
- . The seaming equipment operates properly and is in accordance with manufacturer recommendations.
- . Samples are taken in accordance with specifications.
- . Repairs are made in accordance with approved procedure.
- . Liner is properly anchored around the edges and at penetrations.

2.3.4.2.2 Installed Seam Testing

All seams will be 100% visually inspected and 100% tested using nondestructive methods. The nondestructive test methods will include air pressure tests for double-fusion welds or vacuum tests for extrusion welds in accordance with specifications. All seams shall pass nondestructive test examination.

Final seam acceptance will be based on sample destructive testing. This acceptance is based on the criteria that of three samples taken, two of the three shall pass the specified value and the third sample attain a minimum of 95% of the required value.

Destructive testing will be conducted as follows:

- . Field seam samples for testing will be taken at the beginning and end of each day for each seaming crew and more often if seaming conditions change.

- . Duplicate samples will be taken. One sample will be tested by the geomembrane contractor and one by CQA personnel.
- . Additional samples of seams that visually appear to be defective will be taken at areas indicated by CQA personnel.
- . The date, time, equipment number, seam number, and seaming parameters will be marked on each sample and recorded in a Geomembrane Field Sample Log. -
- . Samples will be field tested for Peel Adhesion, ASTM D 413. Qualification criteria will be film-tear bond-type failures. Tests will be performed in a timely manner.
- . The CQA Officer may require that additional samples be taken from seams not meeting specification criteria. Repair requirements will be directed by KEH based on the results of that additional testing.
- . Samples provided to KEH will be laboratory tested as follows:
 - Test samples will be at least 24 in. in length and 18 in. in width.
 - A minimum of five peel specimens will be tested for each sample in accordance with ASTM D 413.

- At least five specimens from each sample will be tested for bonded shear strength in accordance with ASTM D 3083.
- Laboratory specimens will be conditioned for at least 1 hr prior to testing at the Standard Atmosphere for Testing Geosynthetics in accordance with ASTM requirements.
- Peel tests will be performed on both sides of a double-fusion welded seam.
- The type of failure will be described for each specimen. Disbonding, delamination, fusion or foreign material in the bond area, etc. will be recorded on the Laboratory Test Report. The film-tear bond is the qualifying criteria.
- Generally, the bonded shear strength should be 90% of the tensile strength per unit width of the parent material.
- Specimens showing failure in a grinding or preparation area will undergo seam repair.
- Elongation at failure should be a minimum of 30% when tested in tension.
- Peel adhesion should exceed 60% of the sheet-yield strength of the parent material. Both sides of a double fusion-welded seam must pass the test.

- Peel specimens failing in a grinding or seam preparation area will be noted by the laboratory.

Seams failing the laboratory tests will undergo additional testing and repair.

2.3.4.2.3 Contractor Daily Field Record

The geomembrane contractor will submit a daily field record of the installation and seaming progress for review and retention. Discrepancies will be brought to the attention of the contractor and corrected as appropriate.

2.3.4.3 Post Construction

Post construction will verify final examination and acceptance of the FML installation, verify final documentation is in order and that the liners care and repair instructions have been received. CQA personnel will also verify that the liner material has been provided by the contractor for post construction testing.

2.3.5 Bentonite Carpet Liner

A bentonite carpet liner (BCL) will form the other part of the primary composite liner. Approximately 300,000 ft² of BCL will be installed directly under the FML.

2.3.5.1 Preconstruction

Preconstruction activities for the BCL will include an evaluation of the manufacturers' qualification and material, a review and approval of contractor installation procedure, and an overview of delivery, storage, and handling of the materials.

2.3.5.1.1 Manufacturers' Qualifications and Materials

The contractor shall submit the manufacturer Quality Control Plan and the manufacturers' qualification for review and approval by CQA personnel prior to manufacture of the material. Qualification shall be in accordance with contract specification unless otherwise approved by the Design Engineer. The contractor will be notified of any unacceptable deviations from the specifications.

- . The manufacturer will be required to provide documentation of experience in the manufacturing of bentonite carpet liner.
- . The manufacturer will have a Quality Control Plan that includes the general elements as listed in Section 2 of EPA Guidance Document EPA-530-SW-86-031.
- . CQA personnel will visit the manufacturers' plant to verify the Quality Control Program and to witness the initial manufacturer of the liner.

- . CQA personnel will take samples of the liner components for independent laboratory testing. Two samples will be taken for each lot of primary backing material and cover fabric material used.

The primary backing material will be tested for:

- Weight, ASTM D 3776
- Grab Strength, ASTM D 1682
- Mullen Burst Strength, ASTM D 774
- Puncture Strength, ASTM D 3787

The cover fabric material will be tested for:

- Weight, ASTM D 3776
- Grab Strength, ASTM D 1682
- Mullen Burst Strength, ASTM D 774

The bentonite will be verified for compliance with contract specification.

2.3.5.1.2 Installation Procedure

The contractor shall submit the proposed BCL installation procedure for review and approval. The procedure will be checked for:

- . Procedure for handling, storing, repair, and installation of liner.
- . Equipment requirements.
- . Method for laying liner.
- . Repair procedures.

2.3.5.1.3 Delivery, Storage, and Handling

Delivery, storage, and handling of the BCL materials will be observed by CQA personnel to ensure:

- . Materials delivered to site have not been damaged.
- . Materials are properly stored off the ground and sheltered from adverse weather and UV light.
- . Verify liner is unloaded and stored with a minimum of handling.

Materials that are damaged or unusable will be removed from the site.

2.3.5.2 Construction

Following approval of all preconstruction activities the contractor/installer will be allowed to proceed with the BCL installation. CQA personnel will observe installation for specification compliance.

2.3.5.2.1 Installation

CQA personnel will observe the liner installation for the following items to ensure:

- . Proper climatic conditions for liner installation.
- . Liner is placed in accordance with approved installation procedures.
- . Liner is properly unrolled, positioned, and wrinkles are smoothed out.

- . Proper overlap of panels.
- . Surface to receive liner is dry.
- . Proper orientation of liner material.
- . Proper protection of liner after placement from adverse weather or moisture.

2.3.5.3 Post Construction

Post construction will verify final examination and acceptance of the BCL installation along with verifying final documentation.

2.3.6 Leachate Detection, Collection, and Removal System

The Leachate Detection, Collection and Removal System (LDCRS) will provide containment, monitoring and disposal of any leakage from the basin. The system will be included between the primary and secondary liners and installed following installation of the bottom HDPE liner. The LDCRS includes: synthetic and gravel drainage media, geotextile, HDPE piping, electronic detection, and pump system. The electrical and mechanical equipment components of the LDCRS are discussed in Section 2.3.7 and will be installed in a separate phase of the construction.

2.3.6.1 Preconstruction

Preconstruction activities will include review and approval of contract submittals for Fabricator Drawing and Installation Plans, Manufacturers' Data, Certified Material Test Reports, Manufacturers' Quality Control Plan, and certificates of Installers' experience. CQA personnel will also observe the delivery, storage, and handling of the piping materials to ensure the specified materials are supplied and that they are handled and stored in a manner to prevent damage.

All material will be checked for compliance with the Contract requirement prior to installation.

2.3.6.2 Construction

Following approval of all preconstruction activities and final verification of the acceptance of the bottom liner, the contractor/installer will be allowed to proceed with LDCRS installation. CQA personnel will observe installation of the system and perform testing and obtain samples.

2.3.6.2.1 Drainage Gravel

CQA personnel will visually inspect the drainage gravel upon delivery to the site to ensure that it is clean, washed, and naturally occurring. Crushed aggregate will not be accepted. At least one sample will be taken for each basin constructed. The following analysis and test will be performed:

- . Gradation Analysis, ASTM C 136
- . Constant Head Permeability Test, ASTM D 2434

The size distribution shall be in accordance with contract specifications. Aggregate not meeting the gradation requirements will be rejected and removed from the site.

CQA personnel will observe the placement activities to ensure:

- . Aggregate is placed at locations shown on the drawings in accordance with specifications.
- . The required thickness of material is placed.
- . The aggregate is protected from contamination.

2.3.6.2.2 Synthetic Drainage Media (Drainage Net)

Prior to installation, CQA personnel will check the drainage net and verify the materials have not been damaged and they have been properly stored and handled at the project site.

CQA personnel will perform the following activities during drainage net installation:

- . Observe the placement of the drainage net to ensure it is placed and anchored in accordance with drawings, specifications and installation drawings.
- . Remove roll tags from the drainage net rolls immediately prior to installation, and document in inspection reports.
- . Mark damaged material so that it will be removed and replaced.
- . Obtain samples for testing at the site in accordance with the following:

At least two randomly selected rolls of drainage net will be sampled and tested for each exterior drainage path installed if material changes. Samples will be 3 ft long by full roll width. Drainage net aperture and thickness will be field measured. Hydraulic Transmissivity Tests, ASTM D 4716, will be conducted under conditions representative of the loading the drainage net will experience in service. Additional physical property or performance tests may be required at the discretion of the CQA Officer. The CQA Officer and design engineer will review the test results and compare them with the information submitted by the contractor/manufacturer. Drainage nets not meeting the specification requirements will be rejected and removed by the contractor.

2.3.6.2.3 Geotextile

Prior to installation, the geotextile will be checked for damage during storage and handling at the project site and that UV protection has been maintained until installation.

The CQA personnel will observe the placement of the geotextile to ensure it conforms to the requirements of the drawings and specifications. Each joint overlap will be checked for compliance with specifications. Damaged material will be marked, removed and replaced, or repair in accordance with approved manufacturers' instructions.

The geotextiles will be tested to ensure conformance to the specifications. A minimum of two samples (from different rolls) from each lot will be sampled by CQA personnel. Samples will be full roll width and at least 5 ft long. The inner and outer wraps of the roll will be excluded from the sample.

The following laboratory tests will be performed on the samples:

- . Grab Tensile Strength, ASTM D 4632
- . Puncture Strength, ASTM D 4833
- . Apparent Opening Size, D-4751
- . Thickness, ASTM D 1777
- . Tear Strength, ASTM D 4533

Materials for which the samples did not comply with specifications will be rejected and removed from the project site.

2.3.6.2.4 High-Density Polyethylene Piping

The HDPE pipe will be checked for proper size, material, lengths, and damage prior to installation.

CQA will observe the pipe placement activities to ensure:

- . Proper placement, alignment, and length
- . Proper bonding of joints
- . Pipe perforations are as shown on the Drawings
- . The pipe is kept clean

2.3.6.3 Post Construction

Post construction activities will verify final examination and acceptance of the drainage media, piping, and geotextile. Final examination will verify that the leachate system pump or a similar device can be properly installed and removed as required.

Post construction activities will also verify that all required documentation and record drawings are received and reviewed by KEH.

The system will be checked for dryness before installation of the primary liner.

2.3.7 Mechanical and Electrical Equipment

The piping, pump, instrumentation/electrical components will serve to manage leachate, and basin filling, transferring and draining.

The piping systems from the 242-A Evaporator Building will transfer waste to the retention basins. The pipelines will be constructed of centrifugally cast fiberglass reinforced epoxy pipe and totaling approximately 12,000 lin ft. The pipeline will gravity flow to the basins, be protected from freezing, and be encased to provide spill containment. Valving at the retention basins will regulate flow as required.

The leachate removal piping (HDPE) will extend from the catch basin down between the two liners to the leachate collection sump. A submersible pump will be installed in the bottom of the piping for leachate removal in each basin.

Instrumentation within the pipe encasement and within the basins will alert operation of possible leakage and provide for system shutdown, flow transfer, and leachate removal as required.

Electrical service will provide power for leachate removal pumps, power instrumentation operations facilities, and heat tracing for the above grade piping.

2.3.7.1 Preconstruction

2.3.7.1.1 Mechanical

The mechanical contractor or manufacturer shall submit the following documentation prior to installation of the piping:

. Manufacture

- Quality assurance procedures.
- Catalog data of piping system components.
- Certified results of manufacturers' pressure testing.
- Certified copy of ANSI B31.3 examination and testing.
- Installation instructions for piping.

. Contractor

- Catalog data on leachate and transfer pumps and control valves and accessories.
- Installation, operation and maintenance instruction for valves and pumps.
- Encasement drying procedure.

CQA personnel will observe the delivery, storage, and handling of delivered materials to verify that the various piping types and equipment are clearly identified, that different materials are stored separately, and that material traceability is maintained throughout various construction phases.

CQA personnel will also review records to assure that welding/bonding procedure specifications, procedure qualification records, and welding/bonder performance qualification test results are complete and in accordance with specification requirements. They will also verify that files are complete for personnel certifications and the written nondestructive examination (NDE) performance procedure and that they are in accordance with specifications.

2.3.7.1.2 Instrumentation/Electrical

The instrumentation/electrical contractor, suppliers, or manufacturer shall submit documentation for the following prior to installing of the instrumentation or electrical equipment.

- . Leak sensing and locating cable
- . Level detection system
- . Transformers
- . Electrical cable

CQA personnel will verify that the items meet specifications.

CQA personnel will verify that instrument assemblies are delivered fully assembled and are sufficiently packaged to prevent damage during delivery, storage, and handling. They will verify that electrical equipment and cabling are handled in accordance with manufacturers' recommendations. Items that are damaged will be rejected by the CQA personnel. Delivered materials will be inspected to ensure they conform to requirements of drawings and specifications.

2.3.7.2 Construction

2.3.7.2.1 Mechanical

Pipeline fabrication, welding/bonding, and installation activities will be observed by CQA personnel to verify that the correct piping types, certified welders/bonders, and procedures are used. Joints will be visually examined and NDE conducted in accordance with contract specifications. The pipeline will be surveyed to verify correct alignment and grade prior to acceptance.

The pump assemblies will be tested in accordance with manufacturers' recommendations. They will then be installed at their final location, in accordance with applicable codes, and retested to verify proper operation. CQA personnel will observe the installation and testing of the pumps.

2.3.7.2.2 Instrumentation/Electrical

CQA personnel will observe the installation of electrical and instrumentation material to verify compliance with drawings and specifications, applicable codes, and manufacturers' recommendations.

2.3.7.3 Post Construction

2.3.7.3.1 Mechanical

Following installation of the piping system and prior to final tie-in at the 242 Evaporator the system shall be cleaned, flushed, and dried, as applicable, to assure construction debris has been removed. The system will also be leak/pressure/ hydrostatic tested to verify the

system integrity. CQA personnel will observe all these activities and any part of the system not meeting the specification requirements will be retested.

2.3.7.3.2 Instrumentation/Electrical

CQA personnel will witness the testing of the electrical and instrumentation components to ensure they conform with manufacturers' instructions and applicable codes.

2.3.8 Covers

The waste within the basins will be covered with a mechanically-tensioned (floating) very-low-density polyethylene (VLDPE) liner. These covers will require approximately 300,000 ft² of 60 mil VLDPE liner.

The cover will be installed following the installation of the primary HDPE liner, the basin filling and removal piping, and verification of portable transfer pump insertion test. The cover will also be anchored around the top of the berm to the concrete curb. A cable system will be attached to the cover and through pulleys and weights, a constant tension is applied to form a uniform taut cover atop the liquid waste.

2.3.8.1 Preconstruction

Preconstruction activities for the VLDPE liner will include: an evaluation of the liner manufacturers' qualifications and materials; an evaluation of the installer's qualifications, drawings, and procedures; a review of delivery, storage, and handling methods; an overview of seaming methods and seam testing; and jobsite material sampling.

2.3.8.1.1 Manufacturers' Qualifications and Materials

The contractor shall submit geomembrane material information obtained from the geomembrane manufacturer for review and approval. Deviations from the construction specifications must be approved by the design engineer. The contractor will be notified of unacceptable deviations from the construction specifications. The following manufacturer information will be submitted and approved by CQA personnel prior to installation:

- . Demonstration of Qualification of the Geomembrane Manufacturer: The manufacturer shall provide documentation of experience in manufacturing VLDPE for use in waste containment applications. References of satisfactorily completed projects using VLDPE geomembranes shall be included.
- . Manufacturers' Quality Control Plan: Provide details of the ingredients of the quality control plan. Particularly, document the methods used to ensure only 100% virgin materials are used. At least one sample approximately 2 ft long by full roll width, from each batch shall be obtained each day from each production line in use. The sample shall be divided; the manufacturer will test half and KEH will test the other half for:
 - Thickness, ASTM D 1593
 - Tensile Properties, ASTM D 638
 - Specific Gravity, ASTM D 792
 - Melt Flow Index, ASTM D 1238
 - Carbon Black Content, ASTM D 1603
 - Tear Resistance, ASTM D 1004
- . Certified Material Test Reports: The manufacturer shall provide Certified Material Test Reports that show the materials meet the requirements of the construction specifications.
- . Material and Resin Test Data: The manufacturer shall provide Certified Material Test Reports for the following resin test data:

- Specific Gravity, ASTM D 792
- Melt Flow Index, ASTM D 1238

CQA personnel will verify from the Manufacturers' Certified Material Test Report that the resin used for extrudate fusion welding is from the same materials as the VLDPE sheet resin.

CQA personnel will witness the labeling, packaging, and shipment preparation of the various pieces of geomembrane liner for specification requirement compliance.

2.3.8.1.2 Installer Qualifications, Drawings, and Procedures

The contractor shall submit the following for review and approval:

- . Qualifications of the installer, including key personnel, such as the Superintendent and Foreman.
- . Installation drawings for cover liner and tension system.
- . Installation instructions for cover and tension system.
- . Care and repair recommendations.

The submittals will be reviewed for compliance with the construction drawings and specifications. Unacceptable deviations will be corrected prior

to initiating geomembrane manufacturing and installation operations.

A preinstallation meeting will be held prior to installation of the geomembrane. The following parties will be in attendance:

- . The general contractor
- . The tension system manufacturer
- . The cover system installer
- . The design engineer or his representative
- . The CQA Officer
- . CQA inspection personnel
- . A facility owner/operator representative

The following issues will be discussed and agreed upon by all parties:

- . Field welds and welder qualifications
- . Methods to test seams and sampling requirements
- . Characteristics of a good seam
- . Repair procedures

2.3.8.1.3 Delivery, Storage, and Handling

Delivery, storage, and handling of the cover materials will be observed by CQA personnel to ensure:

- . Fabricated pieces and rolls are wrapped with protective sheeting, made of the same material that is in the containers and supported to prevent damage during shipment.

- . Each roll and prefabricated piece is provided with a label traceable to the manufacturer and the manufacturers' testing results, product type, thickness, batch code, manufacture date, physical dimensions, and roll/panel number or placement number of prefabricated pieces. The labels will only be removed by CQA personnel immediately prior to installation and data being recorded on the Inspection report.
- . A Certified Material Test Report accompanies each roll or prefabricated piece.
- . The liner materials are free of punctures, tears, exposure to high temperatures, bonding of adjacent membranes, or crumpling from inadequate support.
- . The materials are stored off the ground on dunnage, in a secure area and sheltered from adverse weather.

2.3.8.1.4 Test Seams

Prior to geomembrane cover installation and seam welding, the geomembrane contractor will prepare test seams to demonstrate welders, equipment and weld procedures under field conditions outlined in the construction specifications. The test seams will be approximately 10 ft long and will be both destructive and nondestructive tested.

The test seams will be 100% visually inspected and a nondestructive test, either pressure or vacuum box test, will be performed. The entire seam must pass these inspections and nondestructive testing.

Destructive tests will be performed as follows:

- . The test seam, excluding 1 ft on each end, will be divided into two parts. One part will be used by the geomembrane contractor who will perform testing, and the other part will be used by CQA personnel for independent laboratory testing.
- . Seams will be tested by the geomembrane contractor for Peel Adhesion ASTM D 413. CQA personnel may observe these tests. Seam qualification will be evaluated on the basis of film-tear bond type failures.
- . Samples from the part retained by CQA personnel will be sent to the laboratory for testing. The following tests will be performed:
 - Peel Adhesion, ASTM D 413
 - Bonded Seam Strength, ASTM D 3083
- . A minimum of three samples from each part will be tested. Two of the three laboratory samples shall meet the construction specifications and the third sample shall attain 95% of the specified value.

2.3.8.1.5 Material Sampling and Testing

CQA personnel will take random samples of the geomembrane materials delivered to the project site. One sample will be taken for each 50,000 ft² or each lot of material or portion thereof. The following will apply:

- . The samples will be full roll width and at least 2 ft long.
- . The inner and outer wraps of the roll will be excluded from the sample.
- . The field thickness will be measured for each sample taken.
- . Samples will be sent to the laboratory for independent testing. The laboratory testing will include:
 - Thickness, ASTM D 1593
 - Specific Gravity, ASTM D 792
 - Melt Flow Index, ASTM D 1238
 - Carbon Black Content, ASTM D 1603
 - Tensile Properties, ASTM D 638
 - Tear Resistance, ASTM D 1004
- . Material that does not meet the specification requirements will be rejected and removed from the project site.

2.3.8.2 Construction

Following approval of all preconstruction activities, the contractor/installer will be allowed to proceed with the cover installation. CQA personnel will observe installation of the cover and obtain seam test coupons.

2.3.8.2.1 Installation

CQA personnel will observe the cover installation for the following items to ensure:

- . Surfaces are free of sharp objects or debris that could puncture the geomembrane.
- . Proper climatic conditions for liner installation and seaming.
- . The geomembrane material is clean and free of moisture prior to seaming.
- . Welders' qualifications.
- . Proper preparation of the seams.
- . Grinding of the seam areas is not excessive.
- . Geomembrane is not damaged during seaming.
- . Placement of material, including prefabricated pieces, is in accordance with approved installation drawings.
- . The seaming equipment operates properly and is in accordance with manufacturers' recommendations.
- . Samples are taken in accordance with specifications.
- . Tension system is installed in accordance with approved drawings.

- . Cover is properly anchored around the perimeter and at penetrations.
- . Repairs are made in accordance with approved procedures.

2.3.8.2.2 Installed Seam Testing

All seams will be 100% visually inspected and 100% tested using nondestructive methods. The nondestructive test methods will include air pressure tests for double-fusion welds or vacuum tests for extrusion welds in accordance with specifications. All seams shall pass nondestructive test examination.

Final seam acceptance will be based on sample destructive testing. This acceptance is based on the criteria that of three samples taken, two of the three shall pass the specified value and the third sample attain a minimum of 95% of the required value.

Destructive testing will be conducted as follows:

- . Field seam samples for testing will be taken at the beginning and end of each day for each seaming crew and more often if seaming conditions change.
- . Duplicate samples will be taken. One sample will be tested by the geomembrane contractor and one by CQA personnel.
- . Additional samples of seams that visually appear to be defective will be taken at areas indicated by CQA personnel.

- . The date, time and equipment, seam number, and seaming parameters will be marked on each sample and recorded in a Geomembrane Field Sample Log.
- . Samples will be field tested for Peel Adhesion, ASTM D 413. Qualification criteria will be film-tear bond-type failures. Tests will be performed in a timely manner.
- . The CQA Officer may require that additional samples be taken from seams not meeting specification criteria. Repair requirements will be directed by KEH based on the results of that additional testing.
- . Samples provided to KEH will be laboratory tested as follows:
 - Test samples will be at least 24 in. in length and 18 in. in width.
 - A minimum of five peel specimens will be tested for each sample in accordance with ASTM D 413.
 - At least five specimens from each sample will be tested for bonded shear strength in accordance with ASTM D 3083.
 - Laboratory specimens will be conditioned for at least 1 hr prior to testing at the Standard Atmosphere for Testing Geosynthetics in accordance with ASTM requirements.

- Peel tests will be performed on both sides of a double-fusion welded seam.
- The type of failure will be described for each specimen. Disbonding, delamination, fusion, or foreign material in the bond area, etc. will be recorded on the laboratory test report. The film-tear bond is the qualifying criteria.
- Generally, the bonded shear strength should be 90% of the tensile strength per unit width of the parent material.
- Specimens showing failure in a grinding or preparation area will undergo seam repair.
- Elongation at failure should be a minimum of 30% when tested in tension.
- Peel adhesion should exceed 60% of the sheet-yield strength of the parent material. Both sides of a double fusion-welded seam must pass the test.
- Peel specimens failing in a grinding or seam preparation area will be noted by the laboratory.

Seams failing the laboratory tests will undergo additional testing and repair.

2.3.8.2.3 Contractor Daily Field Record

The geomembrane contractor will submit a daily field record of the installation and seaming progress for review and retention. Discrepancies will be brought to the attention of the contractor and corrected as appropriate.

2.3.8.3 Post Construction

Post construction will verify final examination and acceptance of the cover installation, verify final documentation is in order and that the cover operation and maintenance manuals have been received. CQA personnel will also verify that cover material has been provided by the contractor for post construction testing.

2.3.9 Miscellaneous

Several miscellaneous construction items are required to complete the support for the overall basin facility project. They include Cast-in-Place Concrete, Metal Fabrications, and Sealers, Coatings, and Paints.

Normal preconstruction--review and approval of procedures, delivery, storage and handling of materials; construction--progress inspection and material testing; and post construction--final inspection and acceptance activities are standard for all items.

CQA personnel will observe all aspects of these items as detailed in the construction document and verify the following:

2.3.9.1 Cast-In-Place Concrete

- . All submittals in and approved.
- . Proper concrete materials.
- . Proper reinforcing steel materials and fabrication.
- . Proper grout material.
- . Proper form construction.
- . Proper concrete; placement, vibration, finishing, curing, protection, repair, and compressive strength.

2.3.9.2 Metal Fabrications

- . Verify qualifications of welder personnel and procedures.
- . Verify qualification of NDE personnel.
- . Verify proper material being utilized, including filler metal.
- . Verify weld inspection performed and NDE documentation.
- . Verify final fabrication and installation of the items.

2.3.9.3 Sealants, Coating, and Paints

- . Verify proper delivery, storage and handling of the products.
- . Verify proper cleaning before applying products.
- . Verify proper application of primer or pretreatment.
- . Verify proper placement or application of material.
- . Verify proper depth or thickness of material.
- . Verify proper drying time between next application.

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2.4 Sampling

Sampling and testing is intended to verify that the constructed component conforms to the approved design. Sampling and testing is conducted at random in accordance with applicable standards (American Concrete Institute, ASTM, Washington State Department of Transportation [WSDOT], ANSI, American Welding Society [AWS], and EPA guidelines).

If it is determined that existing sampling frequencies are inadequate, based on analysis of reject ratios and trends analysis, the sampling frequency will be increased until such time as the reject ratio improves to an acceptable level.

2.5 Documentation

2.5.1 Daily Record Keeping

2.5.1.1 Daily Summary Reports

Daily summary reports (acceptance inspection reports) shall be prepared by inspection personnel and maintained by the CQA Officer.

2.5.1.2 Inspection Documents

Inspection documents shall be reviewed by the CQA Officer for concurrence with the CQA Plan. A copy of inspection documents shall be available at the site for review and maintained by the CQA Officer in a manner that will allow easy retrieval by basin number, date, or CQA Plan reference number.

2.5.1.3 Problem Identification

2.5.1.3.1 Nonconformance Reports

Construction deficiencies or nonconformances will be documented on an NCR generated by CQA personnel. The

NCR will give a detailed description and location of the deficiency. Nonconformances will be approved by the CQA Officer and the design engineer.

2.5.1.3.2 Sampling Status

The CQA Officer shall monitor sampling status daily for unfavorable trends which would indicate the need for additional sampling or corrective action. In addition, the CQA personnel will maintain a punchlist of problem areas for trending and resolution.

2.5.2 Photographic Reporting Data Sheets

Photographic reporting records may be used as necessary to document unique construction situations.

2.5.3 Block Evaluation Reports

Within each major component of the 242-A Evaporator Interim Retention Basin, there are quality characteristics or parameters that are observed or tested by CQA personnel. The results, or the sampling, analysis and testing will be compiled into a block evaluation summary for that component. These major components and major quality parameters verified are as follows:

- . Foundation/Backfill
Compaction and moisture content.
- . LDCRS
Aggregate gradation, permeability, synthetic drainage media transmissivity, piping installation.
- . Low-Permeability Soil Liner
Compaction, moisture content, gradation, and permeability.

- . Liners
Geomembrane material, and seam quality.
- . Electrical/Mechanical
Proper installation and operation.
- . Cover
Geomembrane material and seam quality.

Statistical analysis including mean and standard deviation will be performed on the test results, as applicable, during construction. The test results and applicable statistical analysis will be summarized in the major component block evaluation report.

2.5.4 Final Documentation

The CQA documentation will be compiled into a report, certified by the CQA Officer, and submitted to the owner/operator, then on to the regulatory authority at the completion of construction. The report will contain the following information:

- . The results of all tests performed on:
 - Foundation/backfill
 - Synthetic and natural drainage media
 - Geomembrane material and installation
 - Piping material and installation
 - Low-permeability soil layer
 - LDCRS
 - Electrical/mechanical equipment
- . Block evaluation report.
- . As-Built drawings.

The final documentation shall reemphasize that areas of responsibility and lines of authority were clearly defined, understood, and accepted by all parties involved in the project. Signatures of the facility owner/operator, design engineer, Contract Administrator, CQA Officer, and construction contractor shall be included as confirmation that each party understood and accepted the areas of responsibility and lines of authority and performed their function(s) in accordance with the contractor Quality Assurance Plan or the CQA Plan, as applicable.

2.5.5 Document Control

The CQA Officer is responsible for maintaining the CQA Plan and updating the plan as approved revisions are processed. The Change Control Record (page i) of the CQA Plan will be used to document changes to the plan. Each page of the plan, including the appendices, will be numbered consecutively. The page number, revision, and date of the revision will be in the top right corner of the page.

Other CQA documentation (i.e., contract drawing and specification, Change Notices, Inspection Plan, Inspection Reports, test reports, Survey Reports, permits, Concrete Pour Slips...) shall be uniquely numbered. The documentation for each basin will be independent and logs will be created for each different document. As appropriate, Inspection Reports, test records, inspection drawings, checklists, etc., will be cross referenced to assure that all aspects of the CQA Plan's inspection points meet the quality requirements throughout the construction of the project.

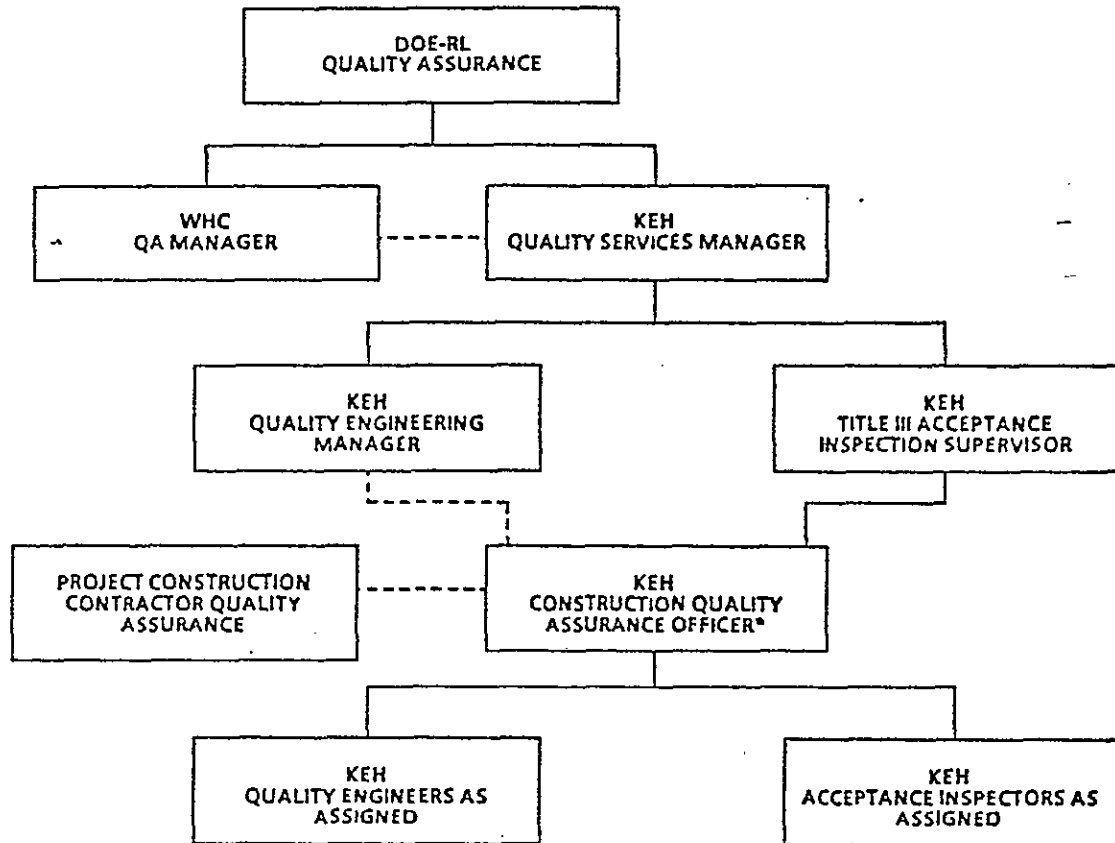
2.5.6 Control and Storage of Documents

During construction, CQA documents will be controlled and stored under the guidance of the CQA Officer. The CQA Officer will ensure that a copy of all applicable documentation is available at the site for review and that all documents are readily retrievable by cross referencing and adequate labeling. Documents as a minimum will be retrievable by:

- . Basin Number (when applicable)
- . Date
- . CQA Plan Reference

QUALITY ORGANIZATION CHART

Quality Organization Chart



- * The Construction Quality Assurance Officer will report to the Acceptance Inspection Supervisor and also work in liaison with the Manager of Quality Engineering. This individual shall assume responsibility to implement the Construction Quality Assurance Plan.

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APPENDIX B

CQA PERSONNEL QUALIFICATIONS

91120

TITLE	CQA Officer
GROUP/DEPARTMENT	Quality Services
EDUCATION	<ol style="list-style-type: none">1) Bachelor's degree in an engineering discipline from a college or university with an accredited program in that engineering discipline, or2) Registration as a Professional Engineer, or3) Associate Arts degree in a technical discipline or military technical training or construction management/inspection training.
EXPERIENCE	<ol style="list-style-type: none">1) Ten yr in construction, engineering, or QA/QC/NDE, including 2 yr supervisory experience, with education (1) above, or2) Six yr in construction, engineering, or QA/QC/NDE, including 2 yr supervisory experience, with education (2) above, or3) Twelve yr in construction, engineering, or QA/QC/NDE including 2 yr supervisory experience with education (3) above.
SUMMARY OF DUTIES	<p>Administer or perform quality engineering services as assigned including:</p> <ul style="list-style-type: none">. Review of design drawings.. Specification review for inclusion of quality requirements and acceptance criteria.. Quality planning and development of estimates.. Constructibility review.. Procurement document review.. Review of project and construction management documents for inclusion of quality requirements.. QA manual maintenance and procedure preparation.. Supplier evaluation.. Issue and control of Qualified Suppliers List.

SUMMARY OF DUTIES
(Continued)

- . Overview of the receiving inspection process.
- . Review document packages prior to turnover.
- . Act for Quality Engineering management, as assigned.
- . Facilitate quality-related interface with the client, affected customers, other Hanford project contractors, and KEH internal organizations.
- . Review and interpretation of acceptance criteria.

TITLE Quality Engineer

GROUP/DEPARTMENT Quality Services

EDUCATION

- 1) Bachelor's degree (engineering, QA or technical) from a school with an accredited program in that discipline, or
- 2) Registration as a Professional Engineer, or
- 3) Associate Arts degree in a technical discipline or military technical training or construction management/inspection training.

EXPERIENCE

- 1) Six yr in construction, engineer or QA/QC/NDE with education (1) above, or
- 2) Two yr in construction, engineering or QA/QC/NDE with education (2) above, or
- 3) Ten yr in construction, engineering or QA/QC/NDE with education (3) above

SUMMARY OF DUTIES Perform quality engineering services as assigned, including approval functions on reviews, design, constructibility, bid packaging, as applicable.

- . Quality planning.
- . Specification input for inclusion of quality requirements and acceptance criteria.
- . Design review.
- . Constructibility review.
- . Contract bid package input and review.
- . Procurement document review.
- . Review of contractor's quality plans and other quality-related submittals.
- . Supplier evaluation.
- . Construction management support; preconstruction conferences, progress meetings, problem areas.

SUMMARY OF DUTIES
(Continued)

- . Participate in surveillances and audits as requested by Performance Assessment group.
- . Initiate NCRs, monitor NCRs.
- . Participate in contract closeout. Sign work acceptance record.
- . Perform quality evaluation of contractor activities.

TITLE Acceptance Inspectors

GROUP/DEPARTMENT Quality Services

EDUCATION

- 1) Bachelor's degree (engineering, QA or technical) from a school with an accredited program in that discipline, or
- 2) Associate Arts degree in a technical discipline or military technical training or construction management/inspection training.
- 3) A High School Degree or equivalent.

EXPERIENCE

- 1) Six mo in related construction or Engineering experience in equivalent inspection, examination or testing - activities, with Education (1) above, or
- 2) One yr of related experience in equivalent inspection, examination or testing activities, with related discipline education (2) above, or
- 3) Three yr of related experience in equivalent inspection examination, or testing activities, with education (3) above.

SUMMARY OF DUTIES

Performance of acceptance inspection and surveillance services on assigned projects or tasks, including assigned approvals. May direct junior grade Acceptance Inspectors.

Performance of Acceptance Inspection activities (the verification of drawings and other documents for conformance to design and working drawings, including inspection or verification of construction workmanship, materials and equipment), as summarized by the following:

- . Acceptance Inspection Services -- Receiving, simple acceptance, acceptance, NDE methods (MT, PT, UT, VT, RT), concrete, earthwork, architectural, structural, mechanical, HVAC, electrical, and instrumentation.
- . Verification -- Testing, change control, as-building.
- . Document Review -- Including Work Acceptance records.

SUMMARY OF DUTIES
(Continued)

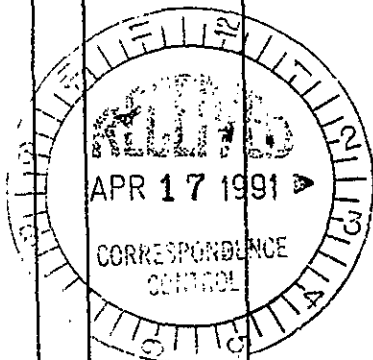
- . Document Preparation -- QS reporting forms, punchlists, deficiency document reviews.
- . Preparation and presentation of training topics.
- . Other activities, as assigned.

DISTRIBUTION COVERSHEET

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